Adaptative strategy to mitigate impacts of repetitive flooding of residents in Thailand’s Ayutthaya province

Nawhath Thanvisithpon

ABSTRACT

This research investigates the socio-economic, behavioral, and psychological consequences of repetitive flooding on the residents of Ayutthaya’s four flood-prone districts. The study also examines the individual-level adaptative strategies adopted by the local residents to coexist with the flooding. The findings revealed several challenges encountered by the flooded households. In addition, most of the respondents expressed a preference to live out the floods in their residences rather than relocating to a makeshift shelter. The ability to live through the floods was largely attributable to the architecture of their residences whereby the houses are raised a few meters above the ground with the living quarter on the upper level, which is the most prominent adaptative strategy. Other adaptative strategies included, e.g., the ownership of a flat-bottom boat and pre-flood stocking-up on basic necessities. Furthermore, in light of the residents’ preference to live out the repetitive flooding, this research also proposes a simple means to enhance the effectiveness of the localized flood relief efforts.

Key words | adaptative strategy, Ayutthaya, flood-related impacts, raised-floor house, repetitive flood

INTRODUCTION

The province of Ayutthaya was an ancient capital of Thailand (AD 1351–1767). It is situated in the country’s Central Plains, approximately 80 kilometers north of Thailand’s present capital Bangkok. In the past, water transport was the principal mode of transportation, given the criss-crossing canals and rivers across the province. At present, Ayutthaya province has been listed by UNESCO as a cultural heritage city and promoted for tourism (Thanvisithpon 2019). Throughout the province, especially in the ancient city area, the remains of ancient architectural structures can be readily spotted. Most of the ancient structures are protected against natural disasters (Makhoul et al. 2016). As the province has become more industrialized, the livelihoods of its people have changed from agriculture to employment in the industry sector (Thanvisithpon 2015). The industrialization of Ayutthaya has also brought with it the urbanization of the flood plains and the land reclamation of the natural waterways that once served as the floodwater storage.

According to Thanvisithpon (2016), Ayutthaya was once Thailand’s important rice-growing area due to the abundant water supply and fertile soils. The significant shift in the socio-economic structure from agriculture to industry occurred when Thailand fully opened its doors to direct foreign investment around four decades ago. Moreover, the proximity of Ayutthaya to the capital Bangkok, where the international airports and shipping ports for exportation of goods are located, has contributed to its rapid pace of industrialization. As the province becomes increasingly industrialized, an increasing number of local residents leave farming for employment in the industry sector. In addition, as a UNESCO cultural heritage city, the province is visited by hundreds of thousands of tourists annually.
The province, in general, and the city of Ayutthaya, in particular, have hastily expanded to accommodate the growing populations, including the expatriates, tourists, and people from other provinces who seek employment in Ayutthaya.

In fact, the industrialization and urban expansion of Ayutthaya, together with the state’s ineffective floodwater management (Zhang et al. 2016) and the mismatch between the decentralized local disaster management and the magnitude of the disaster (Marks & Lebel 2016), contributed to the worst economic damage during the 2011 massive floods, when two-thirds of the country was submerged for months.

However, the province’s current flood-prevention measures are to erect sandbag walls or structural infrastructures around the ancient city (i.e., the tourist magnet) and certain industrial estates, while allowing other less significant archaeological structures and agricultural lands to be flooded. The strategy exacerbates the repetitive flooding situation in the flood-prone areas outside of the flood-protection zones.

Specifically, this research investigates the socio-economic, behavioral, and psychological consequences of repetitive flooding on the residents of four flood-prone districts of Ayutthaya province: Mueng, Sena, Bang Ban, and Pak Hai districts. The study also examines the individual-level adaptative strategies adopted by the residents to coexist with the repetitive flooding. In addition, given the preference of the flooded residents to live through the floods in their residences, a suggestion to improve the effectiveness of the government-run flood relief efforts is put forward, whereby the authorities should take account of the local residents’ way of life in the formulation and implementation of the flood-relief measures.

**RESEARCH METHODOLOGY**

The number of households in Ayutthaya’s Mueng, Sena, Bang Ban, and Pak Hai districts (Figure 1) in 2016 were 49,610, 21,693, 11,671, and 13,733, respectively (Ayutthaya Provincial Office 2016). Following Yamane (1967), the total sample size was therefore 490 households. For ease of comparison, the total sample size was rounded up to 500 households and then 125 households from each of the four districts were randomly sampled as the questionnaire respondents (Table 1). The sampling was random but each

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**Figure 1** | The maps of Thailand, Ayutthaya province and the four districts under study.
household had to have been living there for more than ten years. In the sampling process, one or two households were sampled in each 100 square meters in each district. This was done to minimize the so-called herd mentality effect, where certain behaviors of individuals are influenced by their peers (such as their neighbors), and to increase the diversity of the impact of flood on the samples. Because this research requires a great deal of adaptability to cover the entire study area, information was not obtained at any one point. Therefore, the sampling is based on data from across all areas.

In the data collection, the sampled households in the four flood-prone districts were interviewed using a questionnaire to gather the demographic and behavioral data (including the adaptive strategies), the impacts of repetitive flooding, and the state’s flood relief efforts. The collection of the data was carried out during March to May of 2016. This research also relied on the public data archives, including the natural resources and environmental management policy, the development plans of the Ayutthaya provincial administrative office, and the flood prevention and mitigation plans of the local administrative bodies.

Moreover, the participating households were also asked to rank five flood-induced consequences: daily hardships, travel restriction, stress and anxiety, disruption in business, and flood-borne diseases. These five items were the top five flood-related complaints often made by the local residents, which were garnered from 25 community leaders of the four districts for the questionnaire development. The community leaders are village heads elected by the local residents as their representatives and contact persons with the local government agencies. These village heads are also residents of the four flood-prone districts.

Specifically, the participating households were asked to rank, based on their experiences, the five flood-related items, where the items that had the most and least impact on the participants were given the first and fifth rankings. The weighted average indexes (WAI) were then calculated and the rankings determined.

\[
WAI = \left[ 1^{\text{st}} \text{ rank } (1.0) + 2^{\text{nd}} \text{ rank } (0.5) + 3^{\text{rd}} \text{ rank } (0.33) + 4^{\text{th}} \text{ rank } (0.25) + 5^{\text{th}} \text{ rank } (0.20) / \sum i^{\text{th}} \text{ rank} \right]
\]

where the 1st, 2nd, 3rd, 4th, and 5th ranks are the number of respondents that assign a given flood-induced consequence the first, second, third, fourth, and fifth rankings, respectively; and \( \sum i^{\text{th}} \text{ rank} \) is the total number of respondents.

### Research Findings and Discussion

The findings revealed that as many as 81.4% of the participating households lived in the same house for at least 15 years and that 77.7% of the respondents’ houses were raised a few meters above the ground with the living quarter on the upper level, which is a type of traditional Thai house. In fact, the architecture of the houses is compatible with the repetitive flooding in the province. Furthermore, 32.2% of the respondents were in their current professions longer than ten years, with the top two occupations being hired laborers (56.5%) and small-scale vendors (13.0%).

Given the province’s low-lying geography, 78.1% of the respondents experienced flooding (repetitive flooding) every year and another 14.4% every two years. The floodwater was 1.0–1.5 meters in depth and lasted for 1–2 weeks on average. October and November were the time of year (58.3%) when the areas were normally inundated.

The most prominent adaptive strategy to coexist with the repetitive flooding was the elevation of the houses a few meters above the ground with the living quarter on the upper level, enabling the occupants of the flooded houses to reside in the upper level during the floods. In fact, 88.9% of the respondents expressed a preference to live out the floods in their residences for fear of burglary in their absence, with a staggering 99.3% of those having lived on the upper floor of the house during the previous

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Number of households in the districts of Mueng, Sena, Bang Ban, and Pak Hai and the corresponding sample sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Districts</td>
<td>Denominators</td>
</tr>
<tr>
<td>----------</td>
<td>--------------</td>
</tr>
<tr>
<td>Mueng</td>
<td>49,610</td>
</tr>
<tr>
<td>Sena</td>
<td>21,693</td>
</tr>
<tr>
<td>Bang Ban</td>
<td>11,671</td>
</tr>
<tr>
<td>Pak Hai</td>
<td>13,733</td>
</tr>
<tr>
<td>Total</td>
<td>96,707</td>
</tr>
</tbody>
</table>
floods. This is consistent with Akhter et al. (2013b), who documented that flood victims, despite the flood-induced daily hardships, would choose not to leave their residences.

Moreover, nearly all households in the four flood-prone districts owned a flat-bottom boat. These individual-level adaptations are centuries-old wisdom and practices borne out of necessity rather than the government policies or measures. Specifically, the adaptive strategies enabled the residents of the four districts to live out the persistent floods year after year. However, in the 2011 massive floods, the water levels reached the upper-level living quarters, forcing the occupants to move out of their residences to makeshift shelters (Mongkonkerd et al. 2013).

Other adaptive strategies included the replacement of the wooden house pillars with more durable concrete pillars. The residents also stocked up on clean water prior to the floods, consistent with Cvitanovic et al. (2016). Wooden planks were laid between houses nearby to avoid isolation.

According to Pangapanga et al. (2012), Qasim et al. (2016), Rivera & Wamsler (2014), and Rufat et al. (2015), the locals’ adaptability and preparedness are crucial to the efficiency of the natural disaster relief efforts, especially in the natural disaster that affects many areas and a significant number of people, because it is unlikely for the relief efforts and aid to reach the affected areas in a timely fashion (Surminski & Oramas-Dorta 2014; Tambo 2016).

Despite the adaptability, the repetitive floods nevertheless contributed to stress and anxiety in 55.2% of the respondents. According to Ainiuddin & Routray (2012), Akhter et al. (2015a, 2015b), Anacio et al. (2016), King et al. (2014), Madan & Routray (2015), and Manandhar et al. (2015), flood-related psychological conditions were present in the flood victims despite the adaptive strategies. Thus, moral support and encouragement from family members, friends, and volunteer groups are necessary to help the flood victims better cope with the flood-induced negative psychological conditions (Joerin et al. 2012; Hiwasaki et al. 2014; Haque & Jahan 2015).

The economic impact of the repetitive flooding on the participating residents was surprisingly minimal. This was a short-term study and most study areas were agricultural areas with low population density that received insignificant amounts of flooding, by comparison with the amount during the long-term flooding period. According to Tanaka et al. (2017) and Posner & Georgakakos (2017), short-term flood periods have little impact, with significant rapid recovery. Those who experience frequent flooding are less economically affected, despite the disruption in business and work and the daily wage earners accounting for the largest percentage of the residents’ occupation (56.5% and 13.0% being hired laborers and small-scale vendors). The phenomenon could be attributed to their adaptability, the brief inundation period (1–2 weeks) and the state support for food and basic necessities. Likewise, the post-flood financial burden, except for that of the 2011 massive floods (Thanvisitthpon 2017), is minimal as the houses are raised above the ground and the residents are well adapted. In fact, the physical burden is the largest expenditure as the flood victims were required to expend a few days for the post-flood clean-up.

However, the respondents showed little concern for hygiene and the environment, as evidenced by open defecation practice and improper disposal of feces bags. This was because the toilets, which were normally built on the ground level of the house, were rendered unusable by the floods, forcing the residents to defecate in the open or into a plastic shopping bag and dispose of it into the floodwater. Worse, nearly all of the respondents disposed of the household garbage into the floodwater on a daily basis, rather than retaining it until the post-flood collection, despite the fact that the floods in the province typically lasted only 1–2 weeks on average.

Table 2 tabulates the weighted averages indexes (WAI) and rankings of the top five flood-induced consequences of the residents in the four flood-prone districts in Ayutthaya province. In the table, daily hardships topped the rankings, with a WAI of 0.62, where this term refers to other conditions based on local infrastructure that are affected, such as cooking, electricity, water supply, sanitation. This was followed by travel restrictions (0.52), stress and anxiety (0.43), disruption in business or work (0.39), and flood-borne diseases (0.36). In this research, examples of the daily hardships included power cut, difficulty in meal preparation, toilet inaccessibility. Travel restriction refers to the residents’ limitation to short-distance travel using the flat-bottom boats as the land-based long-distance transportation was rendered
impossible by the floods. Meanwhile, stress and anxiety, disruption in business, and flood-borne diseases are self-explanatory.

### Table 2 | Top five flood-induced consequences faced by the residents of the four flood-prone districts

<table>
<thead>
<tr>
<th>Consequences</th>
<th>Identify</th>
<th>WAI</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily hardships</td>
<td>Ineffective local infrastructure, cooking, electricity, water supply, anxiety, or others</td>
<td>0.62</td>
<td>1</td>
</tr>
<tr>
<td>Travel restriction</td>
<td>Cannot use vehicle normally: longer travel times or cannot travel</td>
<td>0.52</td>
<td>2</td>
</tr>
<tr>
<td>Stress and anxiety</td>
<td>Anxiety during floods and after floods, to the point of requiring psychiatric assistance</td>
<td>0.43</td>
<td>3</td>
</tr>
<tr>
<td>Disruption in business</td>
<td>Losses associated with property and business operations that impact per capita and occupations</td>
<td>0.39</td>
<td>4</td>
</tr>
<tr>
<td>Flood-borne diseases</td>
<td>Diseases caused by floods until they can be treated by a medical unit or hospital</td>
<td>0.36</td>
<td>5</td>
</tr>
</tbody>
</table>

### CONCLUSION AND RECOMMENDATIONS

This research has investigated the socio-economic, behavioral, and psychological consequences of repetitive flooding on the residents of Ayutthaya’s four flood-prone districts: Mueng, Sena, Bang ban and Phak Hai. The study also examined the adaptative strategies adopted by the local residents to coexist with the repetitive floods. The findings revealed that the residents of the four districts expressed a preference to live out the flooding in their residences rather than relocate to the makeshift shelters provided by the local authorities. The ‘stationarity’ of the flooded residents is afforded by the architecture of their residences, whereby the houses are raised a few meters above the ground with the living quarters on the upper level, which is the most prominent adaptative strategy. Other adaptative strategies included the ownership of a flat-bottom boat, pre-flood stocking-up on basic necessities and the replacement of the wooden house pillars with more durable concrete ones.

On the issue of lack of sanitation where the ground-level toilets were rendered unusable by the floods, attempts have
been made by non-profit organizations and civic society (e.g., vocational schools, universities) to produce and distribute cardboard-paper mobile toilets to the residents in the flood-prone districts prior to the floods (in late September) (see Figure 2). One mobile toilet lasts 2 weeks for a 3-to-4-member family and it has been well received by the flood victims. As a result, several state agencies have shown great interest and provided financial resources to scale up the production and distribution. Meanwhile, the disposal of the uncollectable household garbage into the floodwater of the flooded residents could be minimized by hygiene education and the pre-flood provision of proper plastic garbage bags.

Importantly, in light of the existing way of life of the residents of the four flood-prone districts who prefer to live out the repetitive flooding in their residences, the effectiveness of the localized flood relief efforts could be enhanced if the local authorities take into account this fact in the formulation and implementation of the flood relief operation (Thanvisitthpon et al. 2018). For example, the relief efforts should focus on the efficient and speedy distribution of the basic necessities to the flood victims, rather than on erecting more makeshift shelters. This is consistent with Udmale et al. (2014), Vallance & Carlton (2015), and Bohensky et al. (2016), who documented that an understanding of the existing way of life of the residents in the inundated areas at which the flood relief efforts are to be directed would enhance the effectiveness of the efforts.

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institutions from national to local level in India with focus on Delhi. *International Journal of Disaster Risk Reduction* 14 (Part 4), 545–555. https://doi.org/10.1016/jijdrr.2015.10.004.


